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TISHMAN REALTY & CONSTRUCTION CO., INC.
666 FIFTH AVENUE
NEW YORK, N.Y. 10019

OWNERS AND BUILDERS SINCE 1898 JUDSON 2-6700

THE PORT OF NEW YORK AUTHORITY
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WORLD TRADE DEPARTMENT
WORLD TRADE CENTER
PLANNING DIVISION

MARCH 30, 1966

PORT OF NEW YORK AUTHORITY
111 EIGHTH AVENUE
NEW YORK, NEW YORK 10011

ATTENTION: MR. R. M. MONTI, RES. ENGINEER - WORLD TRADE CENTER

RE: FIREPROOFING COST COMPARISON
WORLD TRADE CENTER

DEAR RAY:

WE ARE TRANSMITTING HEREWITH OUR COST COMPARISON AND RECOMMENDATIONS FOR SPRAYED FIREPROOFING. THIS ANALYSIS COMPARES THE COSTS AND MERITS OF VONCO 2, CAFCO TYPE D, SPRAY-CRAFT, FIRECODE V AND MONOCOAT SPRAY MATERIALS. WE HAVE SELECTED FOR COMPARISON, ONLY THOSE SYSTEMS FOR WHICH UNDERWRITERS' LABORATORIES INC. AND/OR NEW YORK BOARD OF STANDARDS AND APPEALS APPROVALS ALREADY EXIST OR ARE IMMINENTLY EXPECTED.

THE ANALYSIS SHOWS AUTHORITY, STRUCTURAL MEMBER SIZE AND FUNCTIONAL FIREPROOFING THICKNESS REQUIRED, FIRE RATING IN HOURS, AS WELL AS COST PER SQUARE FOOT FOR MATERIAL AND LABOR AT THE INDICATED THICKNESS. WE HAVE ALSO INTERJECTED BY NOTE, INFORMATION WHICH WE FEEL IS PERTINENT TO PERFORMANCE AS WELL AS POSSIBLE, HIDDEN ECONOMIES OR EXPENSES.

VERY TRULY YOURS,

TISHMAN REALTY & CONSTRUCTION CO., INC.

JAMES R. ENDLER
ASSISTANT VICE PRESIDENT

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PA LAW DEPARTMENT
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36-12

WORLD TRADE CENTER FIREPROOFING COST ANALYSIS

LABOR AND MATERIAL COSTS REFLECT SPRAYED SQUARE FOOT CONTACT AREA, INCLUDING OVERHEAD AND PROFIT AND N.Y.C. SALES TAX FOR THE INDICATED THICKNESS AND ASSUME LARGE UNCLUTTERED AREAS WHERE FULL PRODUCTION IS ASSURED, BUT DOES NOT PROVIDE FOR EXCESSIVE CLEAN-UP OR SCAFFOLDING. THESE COSTS SHOULD NOT BE USED FOR SPRAY REQUIREMENTS BETWEEN EXTERIOR COLUMN OR SPANDRELS AND THE CURTAIN WALL, SINCE ACTUAL PRODUCTION CANNOT BE DETERMINED.

MATERIAL DESCRIPTION	AUTHORITY (U.L.I.) (B.S.A.)	SIZE OF MEMBER TESTED	INCHES REQ.	FIRE RATING IN HOURS	MAT. $/SQ.FT.	LABOR $/SQ.FT.	TOTAL $/SQ.FT.
"VONCO 2 AND 4 W"	ULI-48-3	8"BEAM	9/16"	5	.225*	.057**	.282
MAGNESIUM OXYCHLORIDE SPRAY MATERIAL AS MANUFACTURED BY THE MD CORP. OF 101 EMPIRE BUILDING, SPRINGFIELD, MISSOURI.	ULI-29-4	10WF49 COL.	2 5/16"	4	.925*	.210	1.135
	ULI-2-1½	10WF49 COL.	1"	1½	.400*	.091	.491
	UNLISTED***	10WF49 COL.	1 3/4"	4	.700*	.159	.859
	UNLISTED***	10WF49 COL.	1½"	3	.600*	.136	.736
	UNLISTED***	10WF49 COL.	1¼"	2	.500*	.113	.613

* MATERIAL COSTS MAY BE REDUCED FROM .05 TO .06 PER BOARD FT. IF A VONCO PLANT IS LOCATED IN THE EAST AS INDICATED BY MR. HARVEY DAVIS OF THE MD CORP.

** LABOR COSTS WERE ASSUMED THE SAME AS THOSE USED FOR SPRAYED CEMENTATIOUS MATERIALS SINCE NO ACTUAL APPLICATION COSTS ARE AVAILABLE FOR VONCO.

*** ULI FIRE TESTS WERE CONDUCTED AND APPROVED, BUT WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE No.1 - THIS COMPANY HAS ALSO CONDUCTED THE FOLLOWING ULI FIRE TESTS ON A 10WF49 COLUMN. THESE APPROVALS ARE NOT LISTED TO DATE.
A) ½" THICKNESS FAILED @ 30 MINUTES
B) 1" THICKNESS FAILED @ 1 HOUR AND 55 MINUTES
C) 2¼" THICKNESS FAILED @ 6 HOURS AND 14 MINUTES

NOTE No.2 - THIS MATERIAL IS REPORTED ACCEPTABLE FOR EXTERIOR APPLICATION AT OUTSIDE TEMPERATURES OF 0°F.

CAFCO TYPE "D" CRYSOTILE ASBESTOS AND MINERAL FIBER FIREPROOFING AS MANUFACTURED BY THE UNITED STATES MINERAL PRODUCTS CO., STANHOPE, N.J. AND CALLED "BLAZE SHIELD".	ULI-86-3 195-65-SM	8" BEAM	½"	4	.075	.041	.116
	ULI-19-3 195-65-SM	14WF228 COL.	1 1/8"	3	.169	.092	.261
	ULI-20-4 195-65-SM	14WF228 COL.	1 3/4"	4	.262	.144	.406

NOTE No.1 - AS PER CAFCO FILE No. C-409, FIELD PAINTING OF STRUCTURAL STEEL MAY BE ELIMINATED WHEN "CAFCO" IS APPLIED DIRECT.

NOTE No.2 - NO TAMPING OR ADHESIVE IS REQUIRED.

NOTE No.3 - MAY BE SPRAYED BY POLE-FIBER-GUN WHICH SHOULD EFFECT SCAFFOLDING COSTS.

MATERIAL DESCRIPTION	AUTHORITY (U.L.I.) (B.S.A.)	SIZE OF MEMBER TESTED	INCHES REQ.	FIRE RATING IN HOURS	MAT. $/SQ.FT.	LABOR $/SQ.FT.	TOTAL $/SQ.FT.
SPRAY CRAFT ASBESTOS FIBER MANUFACTURED BY THE SMITH & KANZLER CORP., 1414 EAST LINDEN AVENUE LINDEN, N.J.	UL1-203-2 502-53-SM	10" BEAM	½"	3	.075	.041	.116
	UL1-81-3	10WF29 BEAM	7/8"	4	.131	.072	.203
	UL1-76-3 502-53-SM	10" BEAM	3/4"	4	.113	.062	.175
	UL1-25-5	8" BEAM	1 7/8"	5	.281	.154	.435
	R2923-12 (OBSOLETE)	COLUMN	3"	4	.450	.246	.696
	UNLISTED*	14WF228 COL.	1 3/4"	5	.263	.144	.407
	UNLISTED*	14WF228 COL.	1 3/16"	4	.178	.097	.275
	UNLISTED*	14WF228 COL.	7/8"	3	.131	.072	.203

* UL1 FIRE TESTS WERE CONDUCTED AND APPROVED BUT WERE NOT INCLUDED IN THE 1966 UL1 BUILDING MATERIALS LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE No. 1 - NO TAMPING OR ADHESIVE IS REQUIRED.

NOTE No. 2 - MAY BE APPLIED WITH POLE-FIBER-GUN, WHICH SHOULD EFFECT SCAFFOLDING COSTS.

FIRE CODE "D" OR "V" SPRAY CEMENTATIOUS AS MANUFACTURED BY THE UNITED STATES GYPSUM CO., CHICAGO, ILL.	UL1-37-5	8"BEAM ONLY	1¼"	5	.108	.119	.227
	UL1-22-3	8"BEAM	1¼"	4	.108	.119	.227
	UL1-24-3	8"BEAM	1½"	4	.124	.136	.260
	UL1-32-3	12"BEAM	1¼"	3	.108	.119	.227
	UL1-67-3	8"BEAM ONLY	1"	3	.077	.091	.168
	UL1-70-3	8"BEAM	1½"	5	.124	.136	.260
	UL1-30-4	10WF49 COL.	2¼"	4	.186	.204	.390
	UL1-13-3	COLUMN	2 1/8"	3	.175	.193	.368
	UL1-23-3	14WF228 COL.	7/8"	3	.072	.079	.151
	UL1-25-3	10WF49 COL.	1 7/8"	3	.154	.170	.324
	UL1-229-2	8 WF BEAM	3/4"	3	.062	.068	.130

MATERIAL DESCRIPTION	AUTHORITY (U.L.I.) (B.S.A.)	SIZE OF MEMBER TESTED	INCHES REQ.	FIRE RATING IN HOURS	MAT. $/SQ.FT.	LABOR $/SQ.FT.	TOTAL $/SQ.FT.
	ULI-31-4						
	UNLISTED*	10WF228 COL.	1 1/2"	4	.108	.113	.221
	UNLISTED*	10WF228 COL.	1 1/8"	4	.092	.102	.194
	UNLISTED*	10WF228 COL.	13/16"	3	.066	.075	.141

* ULI FIRE TESTS WERE CONDUCTED AND APPROVED BUT WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE No. 1 - COSTS INDICATED DO NOT INCLUDE POSSIBLE REQUIRED SCAFFOLDING OR EXCESSIVE CLEAN-UP AND/OR PROTECTION FOR OVERSPRAY.

NOTE No. 2 - MATERIAL COSTS WERE INDICATED BY THE N.Y.C. REPRESENTATIVE OF U.S. GYPSUM CO. (REVISED PRICES).

MONOCOAT	ULI-248-2*	8WF28 BEAM	3/4"	4	.062	.068	.130
CEMENTATIOUS SPRAY FIREPROOFING AS MANUFACTURED BY THE ZONOLITE DIVISION OF THE W.R. GRACE & CO. CHICAGO, ILL.	ULI-23-3**	14WF228 COL.	7/8"	3	.070	.079	.149
	ULI-27-4**	14WF228 COL.	1 1/4"	4	.108	.119	.227

* ULI FIRE TESTS WERE CONDUCTED AND APPROVED BUT
** WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT. (3/4" THICKNESS FAILED @ 4 HOURS AND 10 MINUTES.)

NOTE No. 1 - COSTS INDICATED DO NOT INCLUDE POSSIBLE REQUIRED SCAFFOLDING OR EXCESSIVE CLEAN-UP AND/OR PROTECTION FOR OVERSPRAY.

NOTE No. 2 - MATERIAL COSTS WERE INDICATED BY THE W.R. GRACE & CO.

WORLD TRADE CENTER - FIREPROOFING ANALYSIS

RECOMMENDATIONS

PRESENTLY, IT APPEARS THAT THE SPRAYED FIBER MATERIALS (CAFCO AND SPRAY CRAFT) ENJOY A SLIGHTLY MORE ECONOMICAL APPLIED COST PER SQUARE FOOT THAN THE SPRAYED CEMENTITIOUS (FIRECODE V AND MONOCOAT) MATERIALS BUT NOT ENOUGH TO PRECLUDE KEEPING BOTH IN COMPETITION UNTIL A FINAL BUY IS MADE. NOTE THAT THE FIBER SUPPLIERS HAVE NOT CONDUCTED AS EXTENSIVE A FIRE TESTING PROGRAM AS HAVE THE CEMENTITIOUS MATERIAL MANUFACTURERS. SINCE MORE DATA IS AVAILABLE IN THE LATTER INSTANCE, MORE ACCURATE INTERPOLATION IS POSSIBLE HERE WITHOUT EXPENSIVE ADDITIONAL TESTING.

THE REMOVAL OF BOTH THE TAMPING AND ADHESIVE REQUIREMENTS (BY ACTUAL U.L.I. AUTHORITY) FROM THE FIBER APPLICATIONS, THE APPARENT ABILITY TO SPRAY FIBER WITH ACCURACY FROM THE FLOOR USING THE NEWLY DEVELOPED POLE-FIBER-GUN AND THE RELATIVE EASE OF CLEAN-UP WITHOUT SCRAPING OF OVER SPRAYED MATERIAL, GENERALLY CONTRIBUTES TO THE EDGE IN ECONOMY OF THE FIBER MATERIALS.

THE POSSIBLE REQUIREMENT (ASSUMING THAT AN EXTERIOR GYPSUM BOARD ASSEMBLY PROVES ITSELF) OF CONFINED SPRAYING BETWEEN THE CURTAIN WALL AND EXTERIOR BOX COLUMNS AS WELL AS BETWEEN THE CURTAIN WALL AND EXTERIOR SPANDREL MEMBERS, COULD GIVE THE FIBER MATERIAL AN ADDED ADVANTAGE OVER CEMENTITIOUS, SINCE FIBER EQUIPMENT APPEARS MORE VERSATILE AND EASILY ADAPTABLE TO FAN SPRAYS, NOZZLE MIXING OR SLURRY MIXING (GROUT), SIMPLY BY CHANGING EXISTING SPRAY HEADS OR ADAPTING NEW HEAD CONFIGURATIONS IF EXISTING EQUIPMENT CANNOT BE SATISFACTORILY CONTROLLED.

THE ABILITY OF THE CEMENTITIOUS MATERIAL TO HARDEN OR CRUST AFTER APPLICATION IS A PLUS FOR THIS MATERIAL SINCE DUCT WORK GENERALLY IS SCHEDULED FOR INSTALLATION (BETWEEN TRUSSES) AFTER THE FIREPROOFING OF STEEL, WITH RESULTING DAMAGE TO FIREPROOFING BEING MINIMIZED. MATERIAL COSTS HAVE BEEN DROPPING AND MAY NOT HAVE REACHED BOTTOM.

IT IS RECOMMENDED THAT BOTH SPRAYED FIBER AND SPRAYED CEMENTITIOUS SUBCONTRACTORS BE PLACED IN A COMPETITION WITH EACH OTHER WITH INSTRUCTIONS FOR LOGICAL INTERPOLATION OF REQUIRED THICKNESS OF THEIR RESPECTIVE MATERIALS BASED ON ACTUAL OR UNPUBLISHED UNDERWRITERS' LABORATORIES APPROVALS.

WE ARE IN THE PROCESS OF EVALUATING THE ECONOMICS OF VONCO MAGNESIUM SPRAY VERSUS A SPECIAL WATERPROOFED LAMINATED ASSEMSLY OF GYPSUM BOARD SHEETS FOR THE EXTERIOR OF THE COLUMNS AND SPANDRELS ONLY (WHERE MOISTURE OR TEMPERATURE PRECLUDES OTHER MATERIALS, IN OUR OPINION, WITHOUT EXCESSIVE RE-WORK).

VONCO IS TOO COSTLY FOR FURTHER CONSIDERATION FOR INTERIOR FIREPROOFING APPLICATION.

WHEN THIS ANALYSIS IS COMPLETE, WE WILL RECOMMEND THE MOST ECONOMICAL APPROACH TO THE PROJECT'S EXTERIOR FIREPROOFING REQUIREMENTS. AT THIS TIME, THERE APPEARS JUSTIFICATION TO PURSUE THE INVESTIGATION OF THIS PREFABRICATED LAMINATED ASSEMBLY OF EITHER THE STANDARD 5/8" FIRECODE GYPSUM BOARD OR A SPECIAL BOARD MADE OF FIRECODE V MATERIAL WHICH CONCEIVABLY WILL PERMIT A 4 HOUR RATING WITH A SINGLE 1 1/8" THICK BOARD (U.L.I. 31-4 REVISED) FOR APPLICATION TO THE EXTERIOR FACE OF THE EXTERIOR BOX COLUMNS, PERMITTING THE ERECTION OF CURTAIN WALL AND THE CLOSING IN OF THE TOWER STRUCTURE PRIOR TO APPLICATION OF THE INTERIOR SPRAYED

FIREPROOFING. IF THE BUILDING CAN BE ENCLOSED EARLY IN THE CONSTRUCTION CYCLE, INTERIOR FIREPROOFING WITH EITHER FIBER OR CEMENTITIOUS MATERIAL WILL BE MORE EFFICIENT AND THUS MORE ECONOMICAL.